PATENT

Cancel claims 1-15.

REMARKS

Claims 16-20 remain in the application with independent claim 16 amended to more particularly define the invention and further distinguish the cited prior art.

Non-elected method claims 1-15 are canceled. For the record, the method claims are pending in the parent application serial no. 09/449,063 filed November 24, 1999.

Claims 16-20 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Gardner et al., 6,054,374 in view of Wristers et al., 5,930,620, the Examiner alleging that Gardner et al. teaches all the claimed matter in claim 16 except for the oxygen implants which are used for enhancing the growth of oxide, but a nitride implant is taught which is used to inhibit the growth of the oxide. The Examiner refers to Wristers et al. as allegedly teaching using an oxygen implant to accelerate the growth of an oxide. The Examiner concludes that it would be obvious to combine the teachings of Gardner et al. with the teachings of Wristers et al. allegedly because it is well known in the art that impurities such as nitrogen that are added to an oxide reduce the insulating properties and thermal tolerances causing a lower breakdown voltage of the oxide.

This rejection is respectfully traversed with respect to claims 16-20 as amended. The claimed invention is directed to a semiconductor device having a gate oxide of multiple thickness for multiple transistors. As described in the background of the invention, different types of circuits might have different types of transistors that require different voltage inputs and different thicknesses of gate oxide. For example, a logic field effect transistor might have a different gate oxide thickness than an electrically erasable programmable read-only memory cell transistor or than a dynamic read addressable memory (DRAM) cell transistor. Further, it is generally desirable to make all of the gate oxides for all of the transistors on the chip in a single process step; therefore, it may be necessary to make the gate oxide in some regions thinner than the gate oxide in other regions.

PATENT

Heretofore a technique such as taught by Gardner et al. has been used to vary the thickness of an oxide layer grown on a silicon wafer during an oxide growth process by implanting nitrogen into selected regions of the silicon with the nitrogen retarding the growth of silicon oxide and resulting in a gate oxide of diminished thickness where the nitrogen is implanted. However, implanting nitrogen can degrade the resultant quality of the gate oxide.

In accordance with the invention, a multiple thickness oxide layer is grown by implanting oxygen into selected regions of a semiconductor substrate where a thicker oxide layer is desired. Claim 16 as amended specifies a semiconductor device having a gate oxide of multiple thickness for multiple transistors with a first gate oxide region having a first thickness for a first transistor, and a second gate oxide region having a second thickness for a second transistor, the second gate oxide region being oxygen implanted oxide, and the second thickness being greater than the first thickness.

It is respectfully believed that the claimed semiconductor device as defined by claims 16-20 is not shown or suggested by Gardner et al. taken with Wristers et al. As noted above, Gardner et al. teaches the use of implanted nitrogen to vary the thickness of a grown oxide layer in forming transistors in an integrated circuit. This has problems as described above and as described more fully in the background of the invention in applicant's specification.

Wristers et al. are not concerned with forming a multiple thickness oxide layer for use with transistors having different gate oxide thicknesses, but rather Wristers et al. are concerned with providing a gate dielectric layer of **uniform** thickness within an isolation structure with the oxide thickness in the isolation structure (guard ring) being thicker to reduce the electric field across the guard ring. Wristers et al. are obviously concerned with the problem of electric fields and a recessed guard ring and not with providing gate oxide layers of different thicknesses for different transistors in a semiconductor chip. With due respect, it is not seen how the teachings of using implanted oxygen to grow a thick silicon oxide guard ring can be applied to the growing of thin gate

PATENT

oxide layers of different thicknesses. Only from applicant's specification is this suggestion and teaching found.

For the foregoing reasons, it is believed that the semiconductor device defined by claim 16-20 as amended is neither shown nor suggested by Gardner et al. in view of Wristers et al.

Since claims 1-15 have been canceled, and since claims 16-20 as amended are patentable under 35 U.S.C. 103(a) over Gardner et al. in view of Wristers et al., all of the above as set forth, it is requested that claims 16-20 as amended be allowed and the case advanced to issue.

Should the Examiner have any question concerning the present amendment and response, a telephone call to the undersigned attorney is requested.

Respectfully submitted,

Henry K. Woodward

Henry K. Woodward
Reg. No. 22,672

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, 8th Floor
San Francisco, California 94111-3834
Tel: 650-326-2400
Fax: 415-576-0300
HKW:gcm
PA 3266339 v1

PATENT

VERSION WITH MARKINGS TO SHOW CHANGES MADE

16. (Amended) A semiconductor device having a gate oxide of multiple thickness for multiple transistors, the semiconductor device comprising:

a first gate oxide region having a first thickness for a first transistor, and

a second gate oxide region having a second thickness for a second transistor, the second gate oxide region being oxygen-implanted oxide, the second thickness being greater than the first thickness.

Cancel claims 1-15.